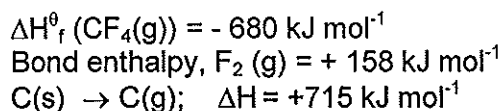


Paper 2 questions

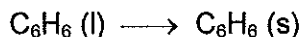
1. (N03)

(a) Given the following data



calculate the average bond enthalpy (in kJ mol^{-1}) for the C – F bond. [4]

(b) (i) For the process



$\Delta H^\theta = -9.83 \text{ kJ mol}^{-1}$ and $\Delta S^\theta = -35.2 \text{ J K}^{-1} \text{ mol}^{-1}$. Predict and explain the effect of an increase in temperature on the spontaneity of the process. [3]

(ii) Calculate the temperature (in $^\circ\text{C}$) at which $\Delta G = 0$ for the above process and explain the significance of this temperature. [3]

2. (N02) The following enthalpy changes (in kJ mol^{-1}) refer to sodium chloride and its constituent elements.

$\Delta H_{\text{formation}}^\theta$	sodium chloride	– 411
$\Delta H_{\text{atomisation}}^\theta$	sodium	+109
$\Delta H_{\text{atomisation}}^\theta$	chlorine	+121
1st ionisation energy	sodium	+494
1st electron affinity	chlorine	–364

(a) (i) State the meaning of the + and – signs in the enthalpy values. [1]

(ii) Explain the meaning of the symbol θ . [1]

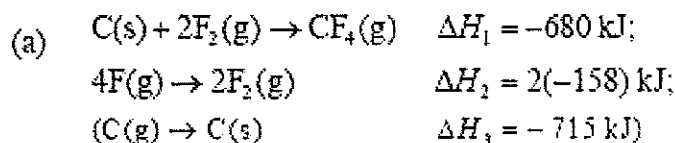
(b) Write an equation, including state symbols, for each of the above enthalpy changes. [5]

(c) The given values can be used to calculate the lattice enthalpy of sodium chloride.

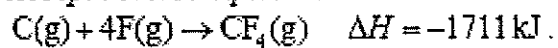
(i) Define the term *lattice enthalpy*. [1]

(ii) Construct a Born-Haber cycle and hence calculate the lattice enthalpy of sodium chloride. [4]

SECTION A



Accept reverse equations with $+\Delta H$ values.



[4]

$$\text{average bond enthalpy} = \frac{-1711}{4} = -428 \text{ kJ mol}^{-1};$$

Accept + or - sign.

Units not needed for mark, but deduct [1] if incorrect units.

No significant figures penalty.

For a correct enthalpy cycle with symbols, award [2].

For correct numerical value (1711), award [1].

For incorrect value, award [0].

For correct average bond enthalpy, award [1] (ECF).

It is possible to score [3] for an incorrect answer.

(b) (i) $(\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ)$

as T increases, $-T\Delta S^\circ$ becomes larger / more positive;

ΔG° increases / becomes more positive / less negative;

process becomes less spontaneous / reverse reaction favoured;

[3]

(ii) $(\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ = 0)$

$$T = \frac{\Delta H}{\Delta S} = \frac{-9830 \text{ J mol}^{-1}}{-35.2 \text{ J K}^{-1} \text{ mol}^{-1}};$$

$$\text{therefore,} \\ = 279 \text{ K} = 6^\circ\text{C};$$

(no SF penalty) ECF

(ECF if kJ used above)

temperature at which solid and liquid are in equilibrium with each other /
 melting point / freezing point / T at which it changes from spontaneous to
 non-spontaneous or vice-versa / T at which no (useful) work is done;

[3]